



MuSES BRDF VV&A

First Phase

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DISTRIBUTION STATEMENT A
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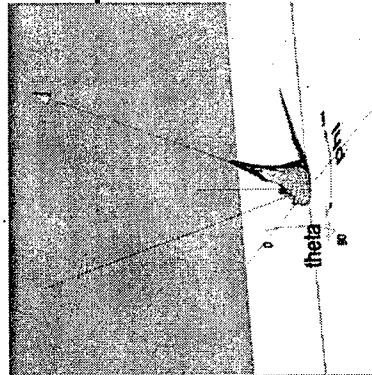
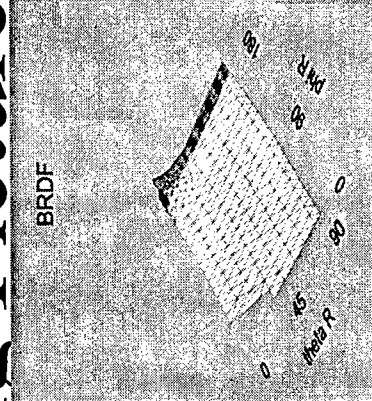
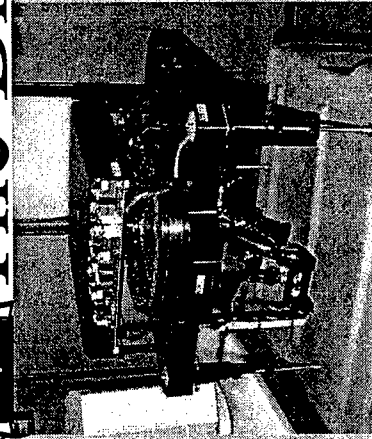
MASTER PLAN



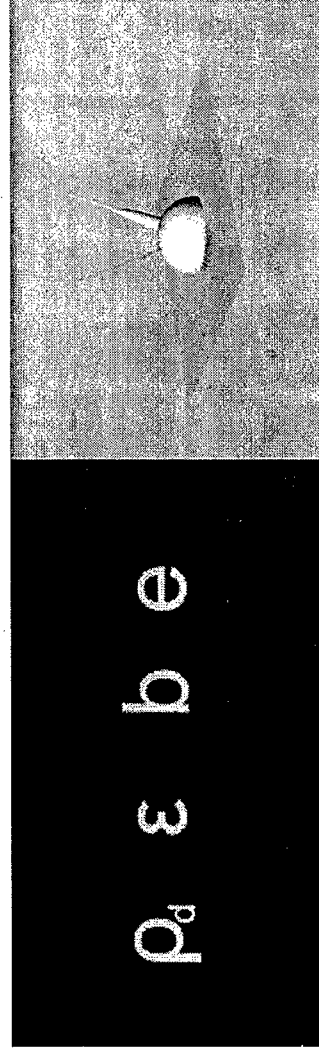
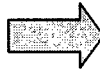
- OBJECTIVES
- BIG PICTURE
- BRDF
- SANDFORD-ROBERTSON
- TEST SETUP
- RESULTS
- LIMITATIONS AND RECOMMENDATIONS
- FUTURE PLANS



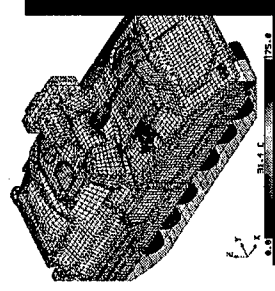
The Big Picture



BRDF measurements



Sanford-Robertson parameters



Physical modeling



OBJECTIVE



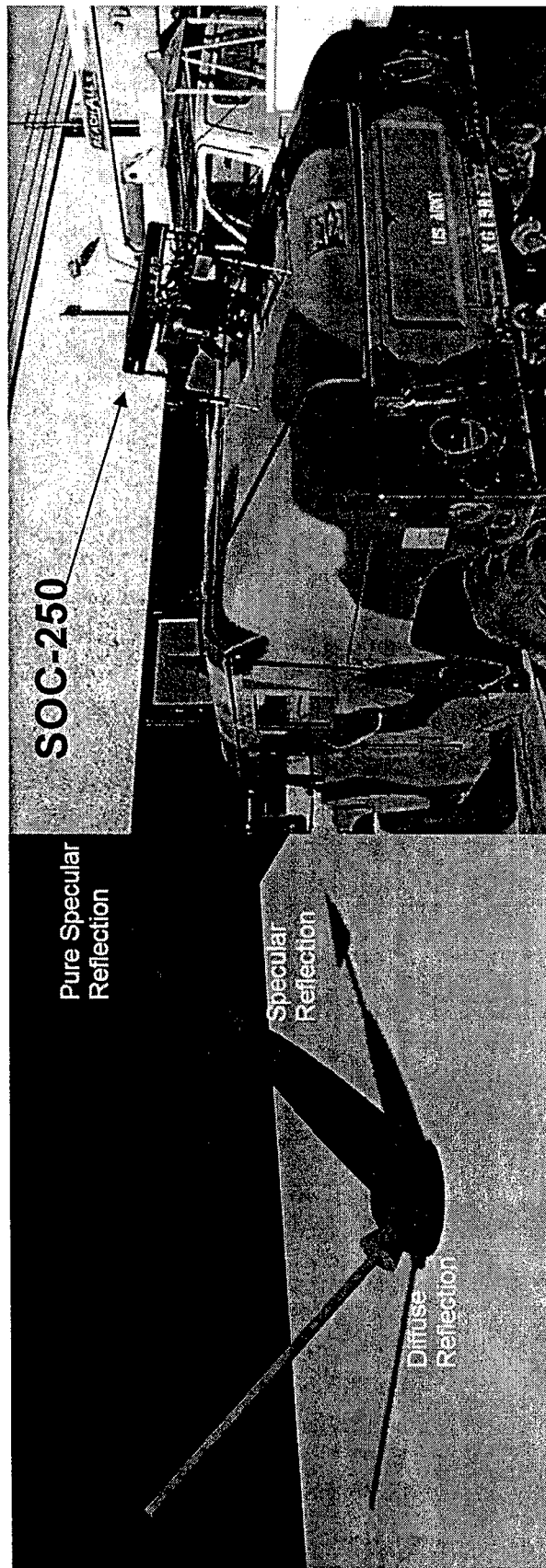
- Enhance the already existing MuSES VV&A
with validation of the BRDF algorithms



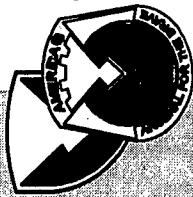
BRDF



A measure of the reflective properties
of a material (i.e. diffuse, specular,
semi-specular, etc.)



5



SANDFORD-ROBERTSON



■ 4 Parameter Model

■ b } Constant for a given surface
■ e }

■ $\rho_D(\lambda)$

■ $\epsilon(\lambda)$

■ Estimation

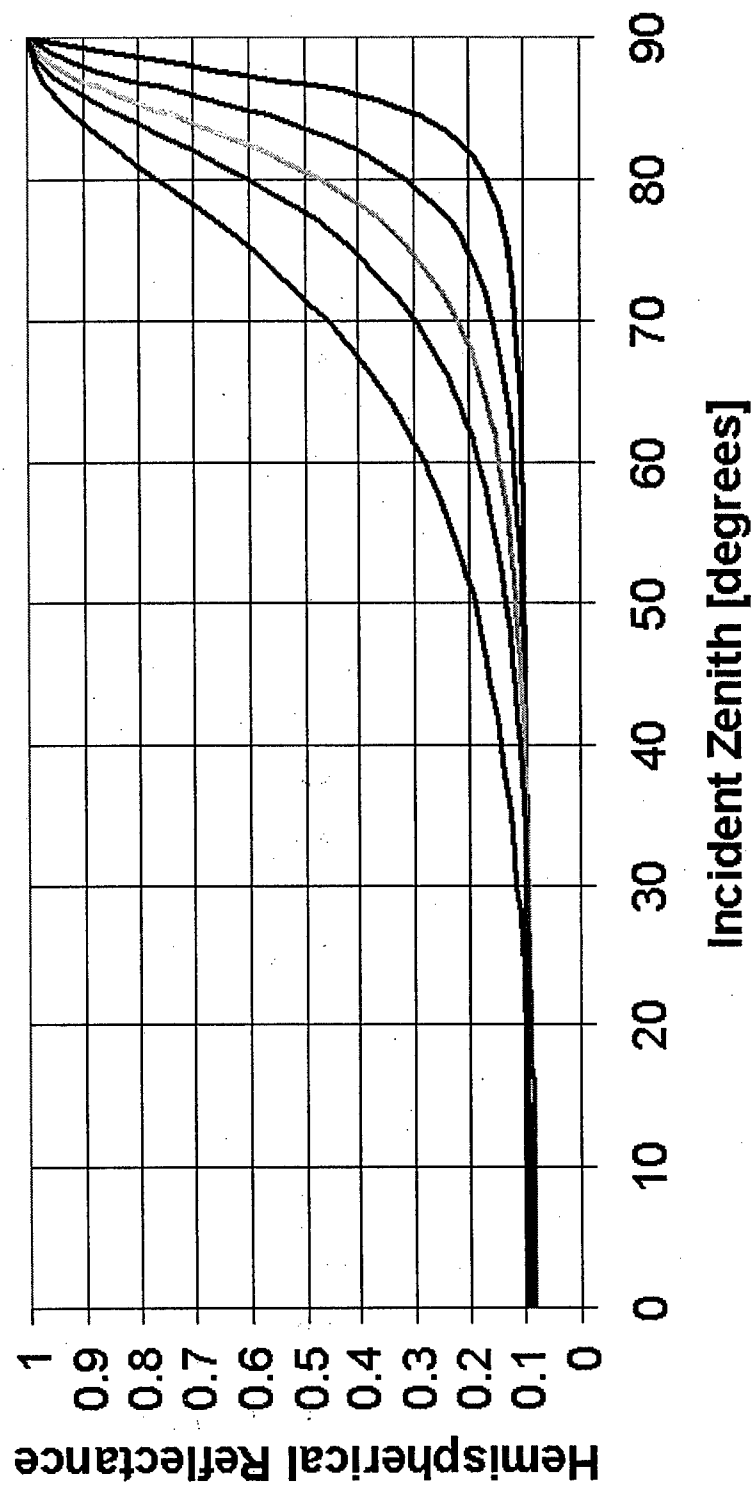
■ Assumptions

■ Ideal Specular Lobe

■ b and e are not λ dependent



SANDFORD-ROBERTSON PARAMETER "b"



— $b=0.05$ — $b=0.10$ — $b=0.15$ — $b=0.20$ — $b=0.30$

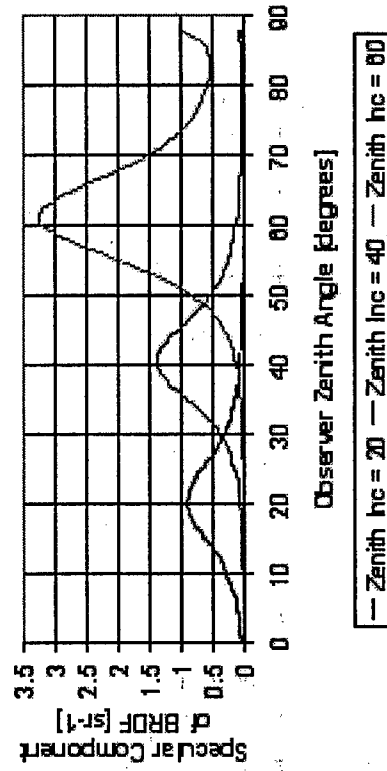
Courtesy of Dave Less, ThermoAnalytics



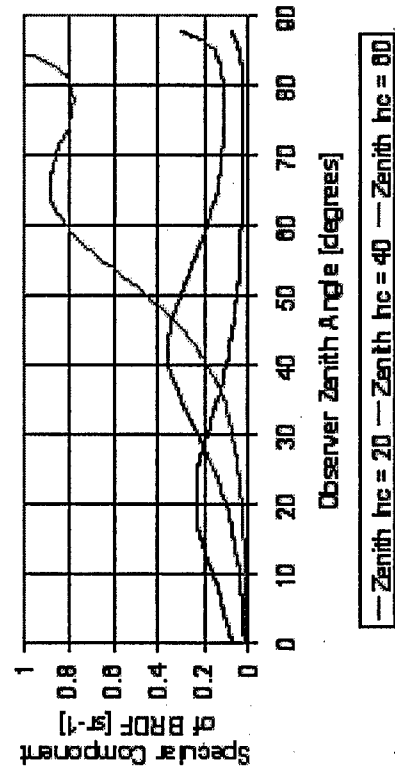
SANDFORD-ROBERTSON PARAMETERS "e"



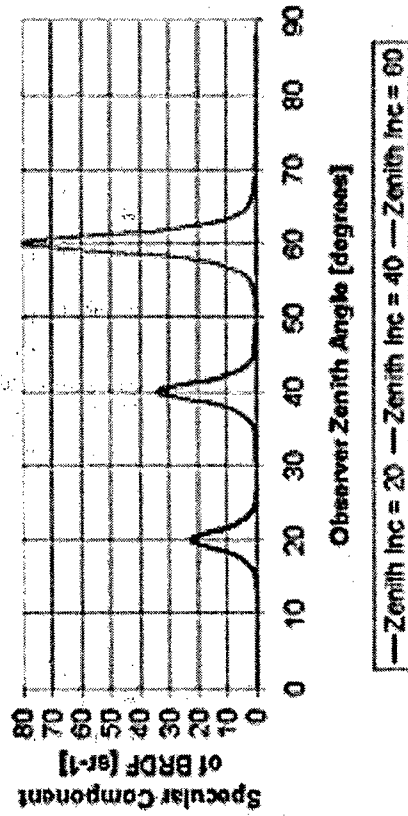
e = 0.10



e = 0.20



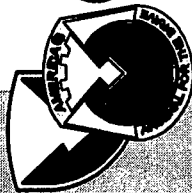
e = 0.02



Courtesy of Dave Less



CREATION OF MODELED DATA



make_sr1 RE, 8/03

Sandford-Robertson Parameters

☐ CARC Green @ 555nm

☐ CARC Tan @ 555nm

☐ Army Black @ 555nm

☐ Army White Primer @ 555nm

☒ Arbitrary (type in)

Parameter Values

ρ	ϵ	b	e
0.6410	0.1000	0.0500	0.3500

Theta Incident (elevation)

45

1

Write RAW mesh

Write Phi=180 Values

☐ axes

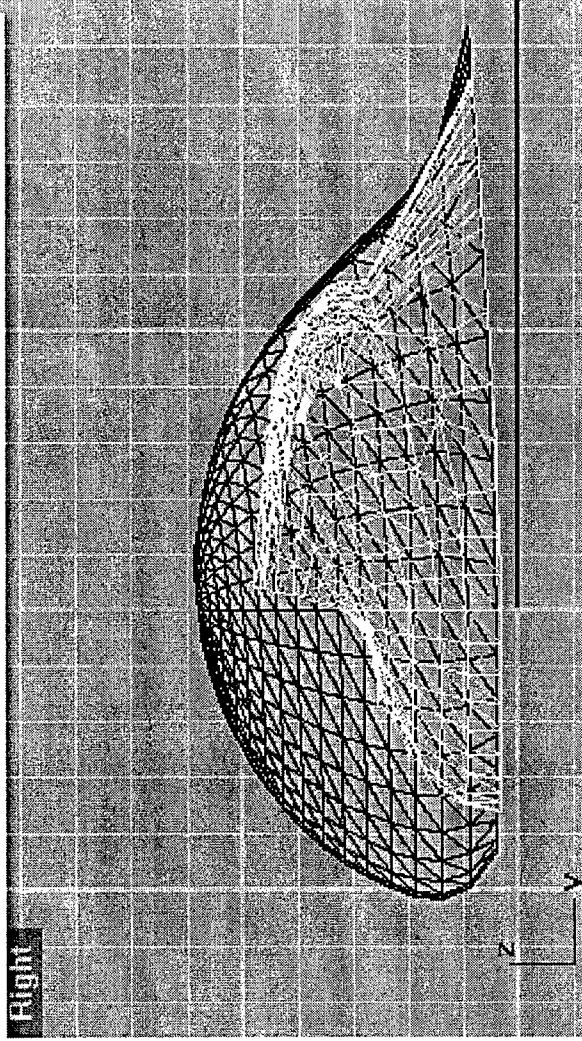
☐ floor

☐ full hemisphere

3-D View [someday]

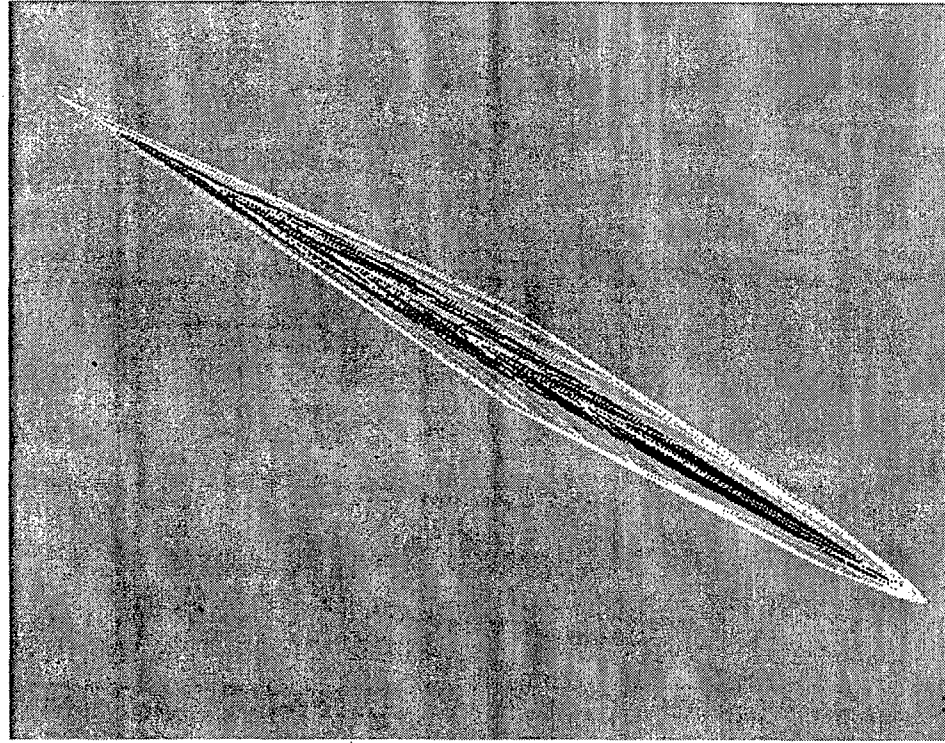
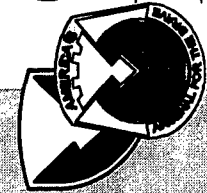


COMPARISON- REAL VS. S-R MODEL



- Pros
 - Smooths Data
 - No Interpolation Necessary
 - Totally Hemispherical

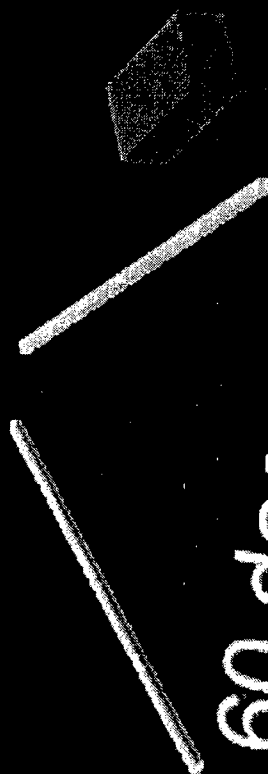
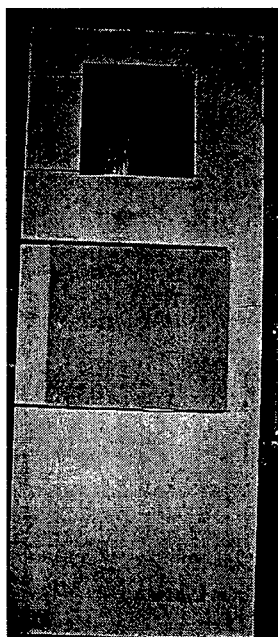
COMPARISON- REAL VS. S-R MODEL



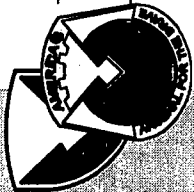
■ Cons

- Can't model atypical BRDF's or anisotropic materials
- Uses Theoretical Calculations (i.e. angle of incidence equals angle of reflection)

TEST SET UP



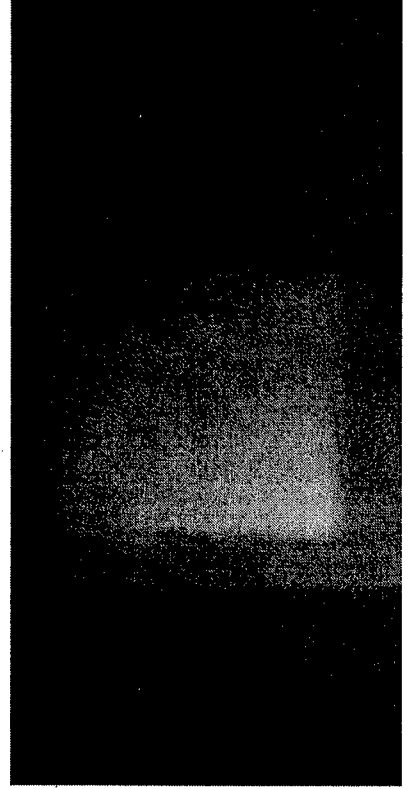
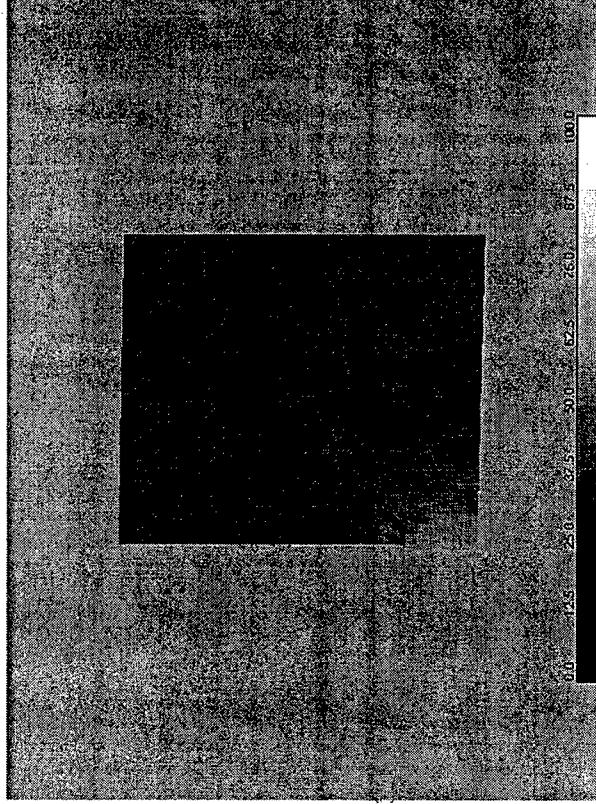
60 degrees



DIFFUSE RESULTS

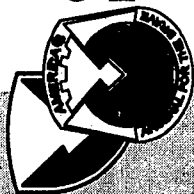


- Similar Properties
- Modeled Data is 10W/m² off
- Must use Weather file
- Must use Paint option

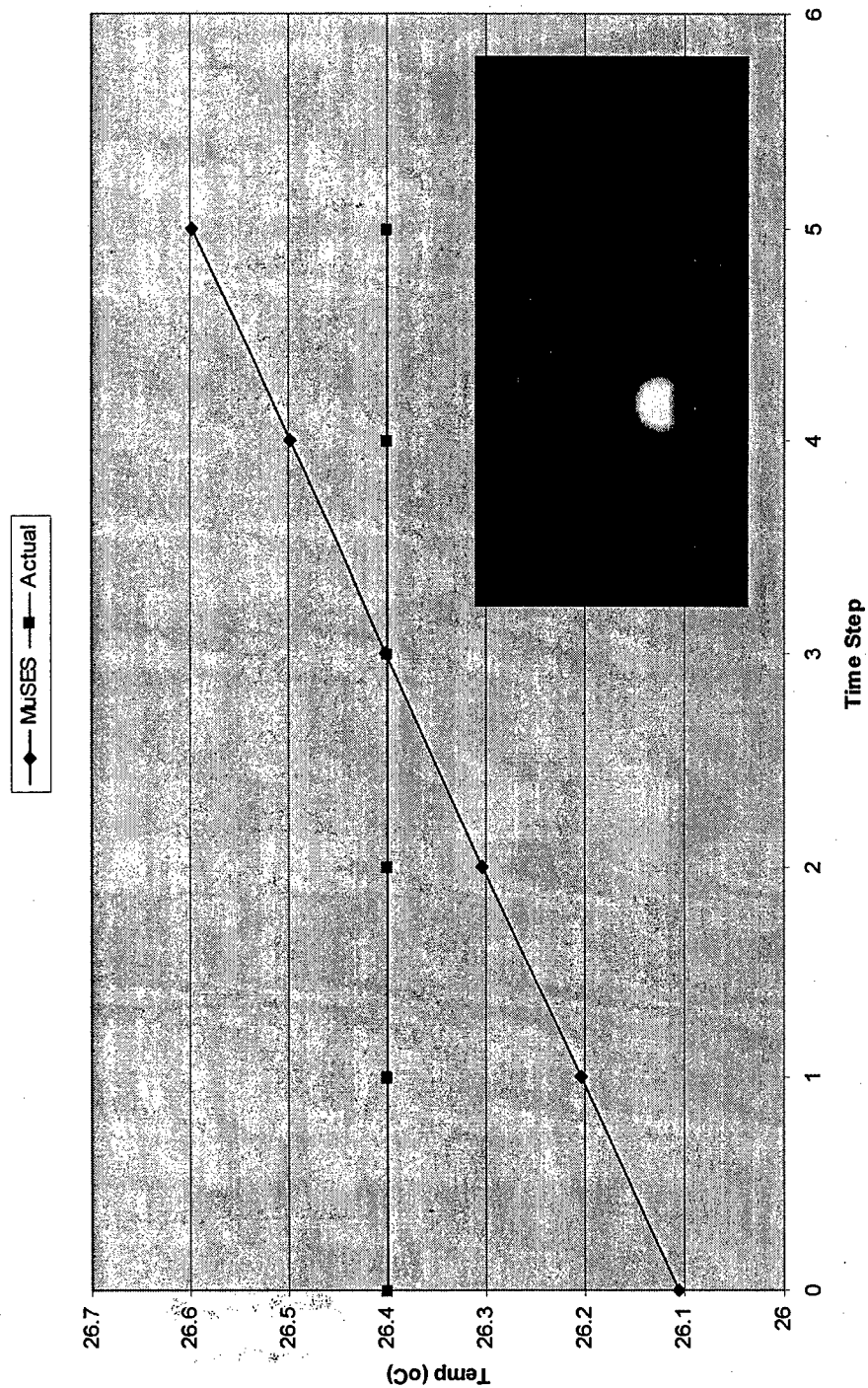




SPECULAR DATA



Physical Temp Comparison (Polished Plate)





LIMITATIONS AND RECOMMENDATIONS

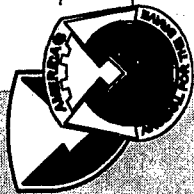


■ LIMITATIONS

- Sandford-Robertson 4 Parameter Model
 - Does Not Allow for Irregular Surfaces
 - Disregards the Wavelength Dependence for Surface Properties

■ RECOMMENDATIONS

- Integrate User Defined Raw Data BRDF Parameters



FUTURE PLANS



- Other Geometrical Shapes for Further Validation
- Environmental Exposure
- Variety of BRDF Panels

16173

OPSEC REVIEW CERTIFICATION

(AR 530-1, Operations Security)

I am aware that there is foreign intelligence interest in open source publications. I have sufficient technical expertise in the subject matter of this paper to make a determination that the net benefit of this public release outweighs any potential damage.

Reviewer: Wallace R. Mick Jr. GS14 Mechanical Engineer
 Name Grade Title
Wallace R. Mick Jr. 2 Sep 03
 Signature Date

Description of Information Reviewed:

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 Purpose of Release: Conference

☒ abstract, summary, or copy of the information reviewed is available for review.

Reviewer's Determination (check one)

- ☒ 1. Unclassified Unlimited. *This presentation contains no military information. The content is routine physics applied to surface reflectance characteristics. I see no problem with unclassified unlimited release. Wally Mick*
- ☐ 2. Unclassified Limited, Dissemination Restrictions IAW _____
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